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### BETTER COWS FROM BETTER SIRES

#### A Study of Cow-Testing Association Records of Dams and Their Daughters

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A dairy cow is seldom the dam of more than half a dozen heifer calves, but a dairy bull may be the sire of hundreds of daughters. The value of a dairy cow depends not only upon her pedigree but also upon her own production records. The offspring play a part, though only a part, in determining the value of a dairy cow; but they tell the whole story regarding the true value of a dairy bull.

The price placed on a dairy bull is sometimes based largely on his pedigree and too often he is purchased solely because he is a purebred. Pedigree alone can never determine his true value. This can be decided in one way only, and that is through the production records of his daughters. If a dairy bull has many daughters and all of these excel medium to low producing dams, the sire has a certain value; if all the daughters excel medium to high producing dams, the true value of the bull is comparatively high; but if all the daughters excel high-producing dams, the true value of that bull is very much greater.

For the first time in the history of this country figures are now becoming available by which the true value of thousands of purebred dairy bulls of each dairy breed may be determined through the production records of their unselected daughters. This information is obtained through the work of the cow-testing associations, which furnish the records not of a few selected daughters, but of all the dams and practically all the daughters, thus telling the whole story.

From various cow-testing associations in many States, 2,182 yearly production records of dams and their daughters have been

received by the Bureau of Dairying. As each of these includes two records, one of the dam and the other of the daughter, the total number of yearly individual cow records is 4,364. These records are of comparatively recent date, nearly all of them having been made within the association years ending in 1922 to 1925.

In many cases the production records of the dam and daughter were for the same year and made in the same herd. Even when the two records were for different years they were usually made under the same or practically the same conditions. Care was taken to eliminate from the tabulations all records that gave advanced-registry figures for one animal and cow-testing association figures for the other. It is therefore believed that the records of dams and daughters are fairly comparable in every respect. In all cases the records of immature dams and of immature daughters were figured to maturity by the method in common use of dividing the production of the 2-year-olds by 70, the 3-year-olds by 80, the 4-year-olds by 90, and in each case multiplying by 100.

#### COMPARATIVE PRODUCTION OF DAMS AND DAUGHTERS

Table 1 compares the average production records of dams and daughters and includes the records of both purebreds and grades. The total number of daughters was 2,182; the total number of dams was somewhat less, as some of the dams had more than one tested daughter; the total number of comparisons, however, was 2,182.

TABLE 1.—*Average production of dams and their daughters, both purebreds and grades*

	Dams	Daughters		Milk	Butterfat
Number of records.....	2, 182	2, 182	Pounds daughters excelled dams..	377	19
Average milk yield.....pounds..	8, 635	9, 012	Per cent daughters excelled dams..	4. 4	5. 6
Butterfat test.....per cent.....	3. 96	4. 01	Times daughters excelled dams.....	1, 259	1, 262
Average butterfat.....pounds.....	342	361	Times dams excelled daughters.....	923	920

The dams produced, on an average, 8,635 pounds of milk, and the daughters 9,012. Therefore, the daughters excelled the dams by 377 pounds of milk, or 4.4 per cent. The dams produced, on an average, 342 pounds of butterfat, and the daughters 361 pounds. Therefore, the daughters excelled the dams by 19 pounds of butterfat, or 5.6 per cent. In production of milk 1,259 daughters excelled their dams, and in production of butterfat 1,262 daughters excelled.

The gains of the daughters over the dams are not phenomenal, but they are very satisfactory, considering the high average production of the dams. The gains would have been excellent had it not been for a few inferior sires whose daughters kept the average production of the daughters down. This is the kind of sire that should be eliminated from our dairy herds. This thought will be developed further in later pages of this bulletin. In general, the tabulations showed that most purebred sires will increase the production of the daughters above that of low-producing dams. However, as the production of the dams increases, better and still better sires must be used or the daughters will not excel the production records of the dams. A small increase of the daughters over high-producing dams



may be a greater credit to the sire than a much larger increase over low-producing dams.

Table 2 compares the yearly records of purebred dams with those of their purebred daughters.

TABLE 2.—Average production of daughters of purebred dams

	Dams	Daughters		Milk	Butterfat
Number of records.....	1,166	1,166	Pounds daughters excelled dams..	333	20
Average milk yield.....pounds..	9,031	9,364	Per cent daughters excelled dams..	3.7	5.6
Butterfat test.....per cent..	3.94	4.02	Times daughters excelled dams.....	665	674
Average butterfat.....pounds..	356	376	Times dams excelled daughters.....	499	492
			Times dams and daughters were equal.....	2	0

In this case all the daughters and their dams are purebred. The high average production of the dams made it difficult for the daughters to win out with a wide margin. The yearly production of the dams averaged 9,031 pounds of milk and 356 pounds of butterfat. It requires a very good sire to raise the production of the daughters above the average of such high-producing dams. On an average, the yearly records of the daughters excelled those of the dams by 333 pounds of milk and by 20 pounds of butterfat, which is a gain of 3.7 per cent in milk production and of 5.6 per cent in butterfat production. In milk production 665 daughters and in butterfat production 674 daughters excelled their dams. On the other hand, 499 dams excelled their daughters in milk production and 492 dams excelled in production of butterfat.

Table 3 compares the yearly production records of the grade daughters of purebred bulls with the records of the dams.

TABLE 3.—Average production of daughters of grade dams

	Dams	Daughters		Milk	Butterfat
Number of records.....	1,016	1,016	Pounds daughters excel dams.....	427	18
Average milk yield.....pounds..	8,181	8,608	Per cent daughters excel dams.....	5.2	5.5
Butterfat test.....per cent..	3.98	4.00	Times daughters excel dams.....	594	583
Average butterfat.....pounds..	326	344			

The production records of both dams and daughters were comparatively high. The high average production of the dams, however, did not prevent the daughters from exceeding that production by 5.2 per cent in milk and by 5.5 per cent in butterfat.

A comparison of Tables 2 and 3 shows that the purebreds had a higher average production than the grades. This was true of both dams and daughters, and it was also true of both milk and butterfat. Though many of the grades had a large percentage of the blood of purebreds, the latter won out all along the line. The high production of the grades was undoubtedly due to their purebred ancestry.

The purebred daughters of purebred cows averaged 9,364 pounds of milk and 376 pounds of butterfat, and the grade daughters of grade cows produced 8,608 pounds of milk and 344 pounds of butterfat, making a difference of 756 pounds of milk and 32 pounds of butterfat in favor of the purebreds.

## GROUP COMPARISONS OF DAMS AND DAUGHTERS

In Table 4 the records are grouped according to the butterfat production of the dams.

TABLE 4.—*Butterfat production of grades and purebreds, a comparison of dams and daughters*

Group	Records	Production range of dams	Average production		Variation of records of daughters from those of dams
			Dams	Daughters	
	<i>Number</i>		<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>
1.....	19	76 to 125 pounds.....	106	297	+191
2.....	50	126 to 175 pounds.....	154	303	+149
3.....	185	176 to 225 pounds.....	205	300	+95
4.....	292	226 to 275 pounds.....	254	308	+54
5.....	471	276 to 325 pounds.....	301	344	+43
6.....	438	326 to 375 pounds.....	350	361	+11
7.....	329	376 to 425 pounds.....	400	395	-5
8.....	182	426 to 475 pounds.....	449	418	-31
9.....	120	476 to 525 pounds.....	499	439	-60
10.....	49	526 to 575 pounds.....	547	421	-126
11.....	20	576 to 625 pounds.....	599	471	-128
12.....	10	626 to 675 pounds.....	641	469	-172

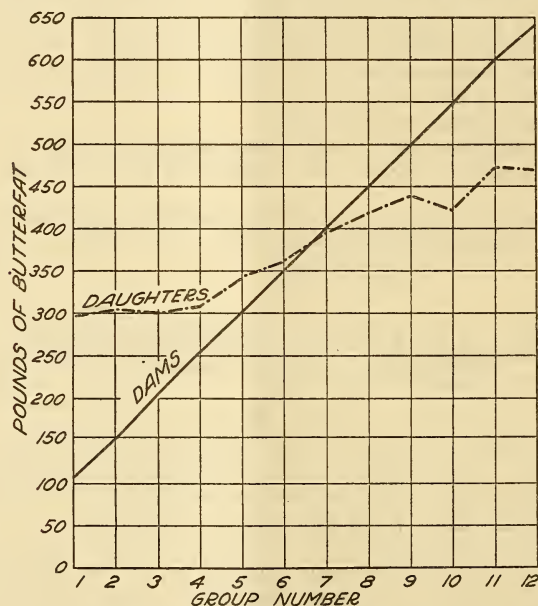


FIG. 1.—This curve is based on the butterfat production of the dams and daughters, as shown in Table 4, and includes the data for both purebreds and grades

The group centers are 50 pounds apart. The average of each group varies only a little from the theoretical center. This is true especially of the larger groups. In making the tabulations in Table 4, groups containing less than 10 records were omitted, which eliminated one group at the beginning and three at the end of the table.

In the first group the daughters excelled the dams by 191 pounds of butterfat. For each succeeding group the daughters excelled the dams by smaller and smaller margins until, in Group 7, they produced on an average 5 pounds less than the dams, after which they fell farther and farther behind the dams, until in the last group their average production was 172 pounds of butterfat below that of their dams.

Figure 1 shows a curve based on the figures given in Table 4. As the curve showing the production of the dams advances, the one showing the production of the daughters gradually climbs, but not so rapidly as that of the dams. Evidently it becomes more difficult for the sires to raise the records of the daughters above those of the dams as the production of the dams increases. For that reason the production curves of dams and daughters gradually come together. The production curve of the daughters crosses that of the dams at 384 pounds of butterfat, after which the average production of the daughters never equals that of the dams.

What does all this mean? Simply that the sires used in cow-testing associations were able to raise the average yearly butterfat production of the daughters above that of the dams until the latter reached 384 pounds. Beyond that point many individual dairy bulls were able to raise the records of their daughters above those of the dams, which the ordinary purebred cow-testing association bull was unable to do. From these figures, it may be safely concluded that the owners of high-producing herds must keep well-bred and highly prepotent dairy bulls. Otherwise, the sires will lower the production records of the daughters and gradually but certainly reduce the herd to a lower level of production.

Table 5 and Figure 2 compare the yearly butterfat production records of purebred daughters and their dams.

TABLE 5.—*Butterfat production of purebreds, a comparison of dams and daughters*

Group No.	Records	Production range of dams	Average production		Variation of records of daughters from those of dams
			Dams	Daughters	
	<i>Number</i>		<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>
1	14	76 to 125 pounds	108	327	+219
2	26	126 to 175 pounds	156	290	+134
3	100	176 to 225 pounds	204	311	+107
4	124	226 to 275 pounds	252	318	+62
5	221	276 to 325 pounds	302	361	+59
6	225	326 to 375 pounds	349	372	+23
7	178	376 to 425 pounds	401	395	-6
8	117	426 to 475 pounds	449	420	-29
9	76	476 to 525 pounds	499	454	-45
10	42	526 to 575 pounds	548	414	-134
11	15	576 to 625 pounds	600	458	-142
12	10	626 to 675 pounds	641	469	-172

Groups of less than 10 are omitted as in Table 4. As the production records of the dams advance, those of the daughters climb, but more slowly. In Group 1 of Table 5, the daughters excel the dams by 219 pounds of butterfat a year. The production line of the daughters crosses that of the dams at about 394 pounds. The average butterfat production of the dams in Group 1 was 108 pounds, and that of the daughters was 327, a difference of 219 pounds per cow in favor of the



daughters. Good purebred sires can easily raise the records of the daughters above those of such low-producing dams. Even in Group 6, where the dams had an average butterfat production of 349 pounds, the daughters averaged 23 pounds more than the dams. In Group 12 the dams have an average production of 641 pounds of butterfat, and the daughters average 172 pounds less than that. Although this group of daughters had the highest average butterfat production of any group, their average production was 172 pounds below that of the dams. The sires that were mated with the high producers were not good enough to maintain the standard set by the dams.

In Table 6 and Figure 3 a comparison is made of the records of grade cows and their daughters which were sired by purebred dairy bulls. This tabulation tells a story similar to those told in Tables 4 and 5.

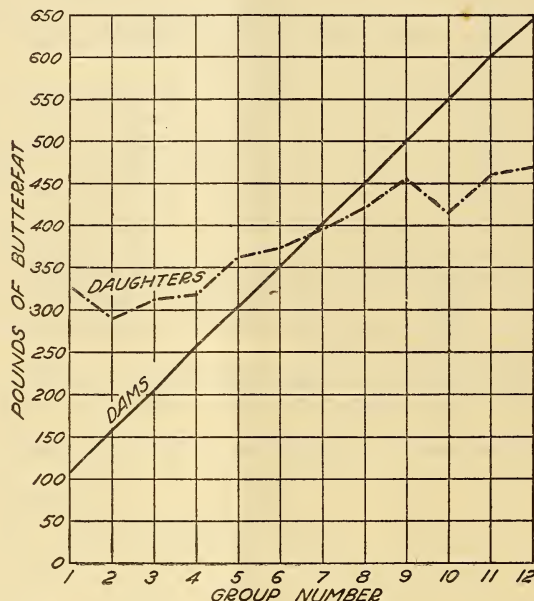


FIG. 2.—This curve is based on the butterfat production of dams and daughters, as shown in Table 5, using only the data for purebreds

TABLE 6.—Butterfat production of grades, a comparison of dams and daughters

Group No.	Records	Production range of dams	Average production		Variation of records of daughters from those of dams
			Dams	Daughters	
	Number		Pounds	Pounds	Pounds
1.....	24	126 to 175 pounds.....	152	318	+166
2.....	85	176 to 225 pounds.....	206	286	+80
3.....	168	226 to 275 pounds.....	252	300	+48
4.....	250	276 to 325 pounds.....	300	329	+29
5.....	213	326 to 375 pounds.....	350	349	-1
6.....	151	376 to 425 pounds.....	400	394	-6
7.....	65	426 to 475 pounds.....	447	413	-34
8.....	44	476 to 525 pounds.....	499	412	-87



At a point very close to 349 pounds, the production line of the daughters crossed that of the dams. In Group 1 of Table 6 the dams averaged 152 pounds of butterfat and the daughters 318 pounds; the daughters, therefore, excelled the dams by 166 pounds. In Group 8 the dams averaged 499 pounds of butterfat and the daughters 412 pounds; the daughters in this group, therefore, produced 87 pounds less than their dams. As a rule, in all the tabulations the higher-producing dams had higher-producing daughters, but the increased production of the daughters did not keep pace with the increased production of the dams.

In Table 7, which is compiled from the data given in Tables 4, 5, and 6, the production averages of the daughters have been smoothed by combining each three consecutive groups and dividing the totals by three.<sup>1</sup> Figure 4 is based on the data given in Table 7.

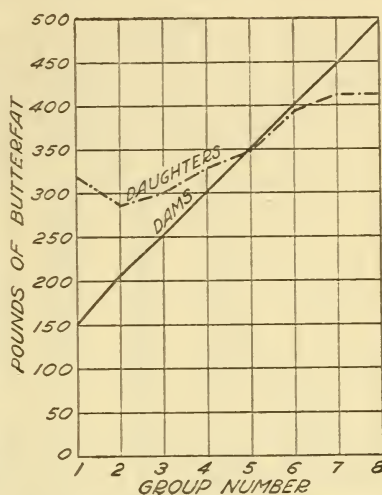


FIG. 3.—This curve is based on the butterfat production of dams and daughters, as shown in Table 6, using only the grade records

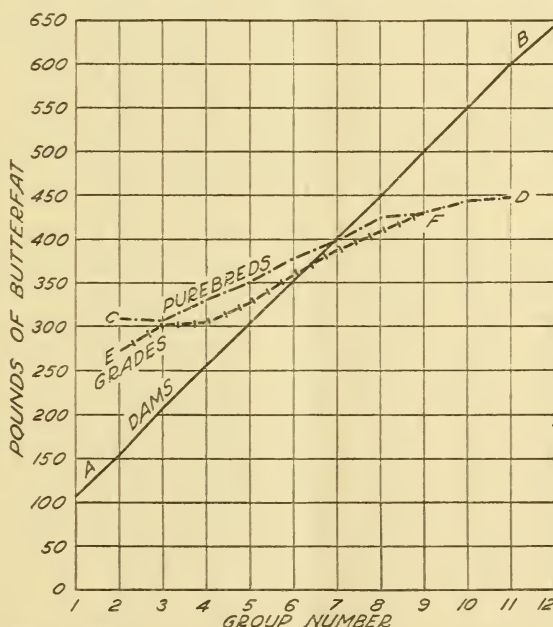


FIG. 4.—These curves are based on the butterfat production of dams and daughters. The curves showing the purebred and grade records are shown separately for the daughters. The curves of the purebred and grade dams coincide

<sup>1</sup> In statistical studies, it is a common practice to use what are called "moving averages" to determine more nearly the trend of the figures and the true direction of the curves, the average of three successive group averages being generally close to the true center of the middle group.

TABLE 7.—Further comparison of butterfat production of dams and daughters  
[The third, sixth, and ninth columns were obtained by using moving averages]

Group No.	Purebreds			Grades			Combined		
	(1) Dams	(2) Daughters	(3) Daughters production smoothed	(4) Dams	(5) Daughters	(6) Daughters production smoothed	(7) Dams	(8) Daughters	(9) Daughters production smoothed
	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
1.....	108	327		98	215		106	297	
2.....	156	290	309	152	318	273	154	303	300
3.....	204	311	306	206	286	301	205	300	304
4.....	256	318	330	252	300	305	254	308	317
5.....	302	361	350	300	329	326	301	344	338
6.....	349	372	376	350	349	357	350	361	367
7.....	401	395	396	400	394	385	400	395	391
8.....	449	420	423	447	413	406	449	418	417
9.....	499	454	429	499	412	429	499	439	426
10.....	548	414	442	539	462		547	421	444
11.....	600	458	447				599	471	454
12.....	641	469					641	469	

In Table 7, columns 3, 6, and 9 were obtained from columns 2, 5, and 8 by applying the principle of moving averages as explained above. In Figure 4 the production line of the dams is represented

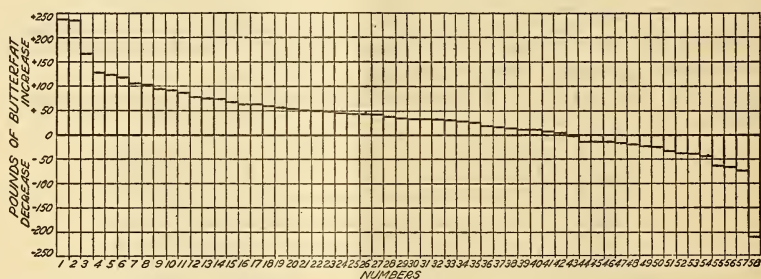


FIG. 5.—The average increase or decrease in pounds of butterfat for five or more daughters of each of the 58 purebred sires, whose records are shown in Table 8

by the practically straight line AB. This line represents the production of the purebred dams, of the grade dams, and of the two combined, because in all cases the averages of the dams followed practically the same line. This is not the case in the production records of the daughters. For all the groups where there were a large number of records the butterfat production records of the daughters of the purebred cows excelled those of the daughters of grade cows.

In Figure 4 the production of the purebred daughters is shown by the line CD and that of the grade daughters by the line EF. Throughout the larger groups, the butterfat production records of the purebred daughters averaged about 20 pounds of butterfat above the records of the grade daughters. This higher production could not have been caused by a difference in the production of the dams, because there was no material difference there. It could scarcely have been caused by a difference in feeding practices, because if the purebred daughters were better fed than the grade daughters it is fair to assume that the purebred dams were better fed than the grade dams. It would seem that the daughters of the purebreds produced more than the daughters of the grades because of their superior breeding, either the greater prepotency of the purebred dams or

the better qualities of the sires, or both. It is probable that better purebred sires are used in purebred herds than in grade herds. This in itself would be enough to explain the greater average production of the daughters.

A comparison has been made of the production of the daughters of 58 purebred bulls in cow-testing associations with the production of the dams. The results are shown in Table 8 and Figure 5. The averages are arranged in the order of the gains in pounds of butterfat of the daughters over the dams, beginning with the largest increase.

TABLE 8.—Comparison of purebred sires,<sup>1</sup> each having five or more tested daughters

Sire	Number of daughters	Milk				Butterfat			
		Dams	Daughters	Increase or decrease		Dams	Daughters	Increase or decrease	
		Pounds	Pounds	Pounds	Per cent	Pounds	Pounds	Pounds	Per cent
1.....	6	4,165	7,958	+3,793	+91.1	224	463	+239	+106.7
2.....	5	10,651	16,364	+5,713	+53.6	351	588	+237	+67.5
3.....	5	7,109	12,212	+5,103	+71.8	275	441	+166	+60.4
4.....	10	10,390	13,754	+3,364	+32.4	362	491	+129	+35.6
5.....	6	12,570	13,175	+605	+4.8	448	572	+124	+27.7
6.....	5	12,947	14,134	+1,187	+9.2	417	536	+119	+28.5
7.....	5	3,645	5,309	+1,664	+45.7	175	280	+105	+60.0
8.....	6	6,853	9,636	+2,783	+40.6	367	471	+104	+28.3
9.....	5	7,317	9,515	+2,198	+30.0	270	365	+95	+35.2
10.....	5	9,105	10,926	+1,821	+20.0	299	390	+91	+30.4
11.....	7	3,336	5,117	+1,781	+53.4	165	251	+86	+52.1
12.....	7	6,039	7,436	+1,397	+23.1	314	392	+78	+24.8
13.....	5	7,133	7,990	+857	+12.0	352	427	+75	+21.3
14.....	5	4,969	6,472	+1,503	+30.2	277	351	+74	+26.7
15.....	6	6,900	7,377	+477	+6.9	316	383	+67	+21.2
16.....	5	5,194	5,616	+422	+8.1	208	271	+63	+30.3
17.....	5	8,339	10,584	+2,245	+26.9	290	353	+63	+21.7
18.....	7	4,692	4,882	+190	+4.0	239	298	+59	+24.7
19.....	5	8,760	10,240	+1,480	+16.9	284	340	+56	+19.7
20.....	7	12,804	14,142	+1,338	+10.4	410	463	+53	+12.9
21.....	6	5,894	6,089	+195	+3.3	269	319	+50	+18.6
22.....	7	9,709	10,748	+1,039	+10.7	335	385	+50	+14.9
23.....	7	10,835	12,521	+1,686	+15.6	372	421	+49	+13.2
24.....	5	6,359	6,782	+423	+6.7	329	374	+45	+13.7
25.....	7	11,524	12,830	+1,306	+11.3	393	436	+43	+10.9
26.....	6	9,951	10,282	+331	+3.3	349	392	+43	+12.3
27.....	6	8,751	10,269	+1,518	+17.3	304	346	+42	+13.8
28.....	5	12,389	12,900	+511	+4.1	432	469	+37	+8.6
29.....	5	11,392	12,533	+1,141	+10.0	407	441	+34	+8.4
30.....	12	11,871	13,449	+1,578	+13.3	414	447	+33	+8.0
31.....	9	12,920	13,772	+852	+6.6	440	473	+33	+7.5
32.....	8	12,217	12,657	+440	+3.6	421	453	+32	+7.6
33.....	5	7,354	8,581	+1,227	+16.7	414	444	+30	+7.2
34.....	5	4,127	4,591	+464	+11.2	196	224	+28	+14.3
35.....	5	6,292	6,935	+643	+10.2	221	246	+25	+11.3
36.....	6	12,902	13,065	+163	+1.3	433	450	+17	+3.9
37.....	8	13,063	13,488	+425	+3.3	445	461	+16	+3.6
38.....	6	13,447	13,792	+345	+2.6	500	513	+13	+2.6
39.....	6	11,702	11,597	-105	-.9	403	414	+11	+2.7
40.....	9	8,010	8,204	+194	+2.4	268	279	+11	+4.1
41.....	6	8,297	8,690	+393	+4.7	451	460	+9	+2.0
42.....	7	8,728	9,434	+706	+8.1	435	439	+4	+1.9
43.....	6	9,482	8,993	-489	-5.2	312	310	-2	-.6
44.....	5	8,067	7,257	-810	-10.0	435	421	-14	-3.2
45.....	5	5,552	4,821	-731	-13.2	267	253	-14	-5.2
46.....	7	7,203	6,566	-637	-8.8	350	336	-14	-4.0
47.....	6	11,755	11,563	-192	-1.6	414	398	-16	-3.9
48.....	7	7,401	6,865	-536	-7.2	360	341	-19	-5.3
49.....	6	12,826	9,787	-3,039	-23.7	402	378	-24	-6.0
50.....	5	5,887	5,210	-677	-11.5	265	240	-25	-9.4
51.....	9	7,711	7,438	-273	-3.5	425	392	-33	-7.8
52.....	5	9,940	8,718	-1,222	-12.3	352	314	-38	-10.8
53.....	5	9,086	7,714	-1,372	-15.1	308	269	-39	-12.7
54.....	5	13,307	11,854	-1,453	-10.9	456	412	-44	-9.6
55.....	5	7,363	6,958	-405	-5.5	419	356	-63	-15.0
56.....	5	6,713	4,799	-1,914	-28.5	310	245	-65	-20.6
57.....	5	10,519	8,090	-2,429	-23.1	379	306	-73	-19.3
58.....	10	9,676	4,825	-4,851	-50.1	499	290	-209	-41.9

<sup>1</sup> Each of the following States furnished four or more of these sires: Wisconsin, 23; Michigan, 7; Iowa, 5; Idaho, 4; Ohio, 4; South Dakota, 4; Vermont, 4.



As shown in Table 8, the daughters of sire No. 1 produced, on an average, 239 pounds more butterfat than their dams; those of sire No. 20 averaged 53 pounds more than their dams; and those of sire No. 40, only 11 pounds more; whereas the daughters of sire No. 58 averaged 209 pounds below the butterfat average of the dams. Forty-two of these sires increased the butterfat production of their daughters over the production of the dams of those daughters, whereas 16 showed a decreased average.

The fact that the daughters of any sire excel their dams in production of butterfat is a very important factor, but it is not the only factor to be considered. It makes a big difference whether the production of the dams is high or low. For example, some of the sires near the head of the list in Table 8 were mated with rather low-producing dams, which fact accounts in large part for the great increase of the records of the daughters above those of the dams. In like manner it may be noted that some of the sires near the foot of the list were mated with rather high-producing dams, and that fact accounts in large part for the failure of the daughters to produce as much as the dams. Evidently the sires near the head of the list are fit to be used in the herds in which they are found, and those near the foot of the list are not good enough to be used in the herds in which they are found. That does not mean that all the sires whose daughters failed to equal or excel the dams in production of milk and butterfat should be sent to the butcher; but it does mean that, if kept at all, they should be used to improve lower-producing dairy herds.

Table 9 gives the individual yearly milk and butterfat records of the five daughters of sire No. 2. In every case the daughter excelled the dam in production of both milk and butterfat.

TABLE 9.—*Records of the five daughters of sire No. 2*

Milk production		Butterfat production	
Dam	Daughter	Dam	Daughter
<i>Pounds</i>	<i>Pounds</i>	<i>Pounds</i>	<i>Pound</i>
14,445	18,592	440.7	625.0
14,445	19,629	440.7	722.9
12,396	17,942	489.0	692.4
5,984	14,384	191.2	510.0
5,984	11,272	191.2	387.6
Av. 10,651	16,364	351	588

The daughters excelled the dams by an average of 5,713 pounds of milk, or 53.6 per cent, and by 237 pounds of butterfat, or 67.5 per cent. This is a large gain both in production and in percentage of production. A sire that can place the average butterfat production of his daughters at 588 pounds when that of the dams is 351 pounds, and that can keep the production of every daughter above that of a high-producing dam five times in succession, is a sire to attract attention. These are the sires that the cow-testing records of dams and daughters are placing in the limelight. The fact that so few of these bulls are kept until the records of the daughters are available means a great loss to the dairy business.



In the case of sire No. 58, as given in Table 10, each of the 10 daughters produced less than her dam.

TABLE 10.—Records of the 10 daughters of sire No. 58

Milk production		Butterfat production		Milk production		Butterfat production	
Dam	Daughter	Dam	Daughter	Dam	Daughter	Dam	Daughter
Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
7,798	5,639	536.0	310.9	10,937	4,279	530.4	245.6
7,965	4,272	429.9	257.8	9,694	3,902	506.6	330.8
8,627	3,144	416.1	201.7	9,694	5,579	506.6	346.3
11,488	5,567	566.8	322.3	10,096	6,767	506.4	399.2
11,488	5,008	566.8	263.6				
8,976	4,096	425.9	218.2				
				Av. 9,676	4,825	499	290

The dams produced an average of 9,676 pounds of milk and 499 pounds of butterfat; the daughters, 4,825 pounds of milk and 290 pounds of butterfat. The daughters produced an average of 4,851 pounds of milk, or 50.1 per cent, and 209 pounds of butterfat, or 41.9 per cent, less than the average of the dams. Though the records of the dams were comparatively high in both milk and butterfat, those of the daughters were certainly not flattering to their sire. In every case the daughter of this sire failed to produce as much as her dam. It hardly seems possible that chance caused the first 10 daughters tested to be lower producers than their dams. Certainly no owner of such a dairy herd can afford to keep this kind of sire.

The butterfat records of dams and daughters in Table 9 make an interesting comparison when placed beside those in Table 10. In one case, the sire raised the record from 351 to 588 pounds; in the other, the sire lowered the record from 499 to 290 pounds. Sire No. 2 should be kept until he has hundreds of daughters, but sire No. 58 has already been kept too long.

In the case of the 12 daughters of sire No. 30, some of the daughters excelled the dams and some did not. (Table 11.)

TABLE 11.—Records of the 12 daughters of sire No. 30

Milk production		Butterfat production		Milk production		Butterfat production	
Dam	Daughter	Dam	Daughter	Dam	Daughter	Dam	Daughter
Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
8,188	9,868	310.0	362.6	9,893	12,131	348.6	415.5
14,071	16,110	529.3	517.1	13,351	15,168	463.8	511.8
13,542	11,941	415.4	379.5	12,142	16,188	475.8	506.1
13,542	12,687	415.4	407.6	12,405	13,200	457.1	439.1
10,807	15,469	376.9	530.8	9,893	13,710	348.6	499.4
13,738	12,136	445.1	392.4				
10,877	12,777	376.9	404.0				
				Av. 11,871	13,449	414	447

The 12 daughters excelled their dams by an average of 1,578 pounds of milk, or 13.3 per cent, and by 33 pounds of butterfat, or 8 per cent. Even though the sire did not win out in every case, the record was a very good one. It can hardly be expected that a sire

will raise the record of every daughter above that of dams like these. In sizing up a dairy bull, almost as much attention should be given to the records of the dams as to those of the daughters.

#### PROVED SIRES <sup>2</sup>

Most purebred dairy sires have some daughters that excel the dams and others that do not. If less than half the daughters excel the dams, the herd is going down. If more than half excel, the herd is improving. If all, or nearly all, excel, the herd is improving rapidly. To measure improvement in the dairy herd, the production records of both dams and daughters must be obtained. They are furnished at a comparatively low cost by the cow-testing association. Where such associations are impracticable, the owner of the dairy herd should in some other way determine the production records of each cow in his herd.

The keeping of the records of dams and daughters is not enough. Some practical method must be found for keeping a dairy bull until enough of his daughters have been tested to show his worth. If the comparative records become available only after the bull has gone to the butcher they have lost their value so far as that sire is concerned.

It is possible that some system of exchange may be worked out in each community by which dairy bulls may be kept until the records of the dams and daughters determine their true value as dairy sires. From that time on, if a bull is proved worthy, he should be kept at the head of some dairy herd. If he is proved to be an outstanding bull, he should become the sire of a large number of high-producing daughters and thus help greatly in raising the average production of the dairy herds in the community.

It has been the custom in times past to determine the value of a dairy bull by looking up the production records of his dam and granddams and by paying some attention to the records of his sisters and his aunts. That is good so far as it goes, but the time is gradually approaching when the dairy sire will be valued according to the records of his daughters, and when every up-to-date dairyman will be dissatisfied until he has a proved sire at the head of his dairy herd.

Almost every dairy district in this country can furnish a story, based on actual occurrence, of a great dairy bull sent to the butcher before his true value became known. Already true stories of a different kind are beginning to come in from the cow-testing associations, stories in which the records of the daughters saved the lives of highly prepotent dairy sires.

In a certain cow-testing association in a dairy district of the Central West there was a purebred bull called "Billy." After he had been in the herd two years it was decided to send him to the butcher to prevent inbreeding. "For a time," as the tester reported, "things looked bad for Billy; he was headed straight for the block." Just in the nick of time, six of his daughters completed yearly records. Figured to maturity, the average production of the daughters was 7,886 pounds of milk containing 397 pounds of butterfat. This was 1,918 pounds more milk and 105 pounds more butterfat than

<sup>2</sup> In this bulletin the term "proved sire" means a sire having five or more daughters whose yearly milk and butterfat records have been compared with the production records of their dams.



the average produced by the dams. These records saved Billy's life, and he was placed at the head of a purebred herd.

In another cow-testing association in 1924, a purebred bull was at the head of a small dairy herd. The owner of the herd did not appreciate the value of the bull and was about to sell him to the butcher. Before this took place, however, the production records of the daughters began to tell their story. The owner decided to keep the bull until the figures for the year were complete. At the end of the testing year there were five complete records of the daughters of that sire, and the dam of each daughter had also made a yearly record. In milk production the dams averaged 10,651 pounds and the daughters 16,364. In butterfat production the dams averaged 351 pounds and the daughters 588. In both milk and butterfat production every daughter excelled her dam.

Since these records became available the dairy-extension field man in another State has tried to buy that bull for use in a cooperative bull association, but the owner feels that the sire with such a record is needed to improve the herds of the home community. That bull will not be sold to the butcher so long as he is fit for breeding.

The cow-testing association records have already proved a number of dairy bulls. Records of the daughters of a large number of dairy bulls have been tabulated by the Bureau of Dairying, and 58 of these sires each had 5 or more daughters that have completed a yearly test. All these records of dams and daughters have been figured to maturity, and the results have been returned to the States from which the records came. It is only through the splendid cooperation of the States that this work has been possible. An attempt is now being made to determine how many of these sires are still alive, because there is not much to be gained by proving a dead bull.

The proved purebred dairy sire seems to be the best solution of the dairy-breeding problem. He may be proved through cow-testing association figures, through advanced-registry testing, or through private records. How such sires may be kept until the production records of the daughters become available is one of the unsolved problems of the dairy world to-day. Every dairyman is interested in its solution.

#### SUMMARY AND CONCLUSIONS

This bulletin shows how the true value of a dairy bull may be measured through cow-testing association records by comparing the yearly production records of the daughters of the sire with those of the dams of the daughters.

The conclusions are based on a comparison of the yearly production records of 2,182 daughters of purebred bulls with those of the dams of the daughters. As some of the dams had two or more daughters, the number of dams was somewhat less than 2,182.

The yearly production of 2,182 daughters of purebred dairy sires was 9,012 pounds of milk and 361 pounds of butterfat. In milk production the daughters excelled the dams by 377 pounds, and in butterfat production by 19 pounds. This small average gain of the daughters is particularly significant, since the average production of the dams is so high. The average production of 1,166 purebred daughters was 9,364 pounds of milk and 376 pounds of butterfat,

that of 1,016 grade daughters of purebred bulls was 8,608 pounds of milk and 344 pounds of butterfat.

The daughters of purebred cows excelled the dams until the records of the dams averaged 394 pounds, and the daughters of grade cows excelled their dams until the records of the dams averaged 349 pounds. This means that the daughters of purebred cows excelled their dams by a larger margin than did the daughters of grade cows. Evidently the sires used in purebred herds were superior to those used in grade herds.

The study of individual sires, each having five or more daughters, showed that in some cases all the daughters excelled the dams; in other cases some of the daughters excelled and some did not; and in still other cases every daughter produced less than her dam. This shows the necessity of using great care in the selection of a dairy sire.

Some sires increased the records of the daughters over fairly high-producing dams more than 40 per cent; other sires lowered the production of the daughters almost as much below that of similar dams.

The individual cow records show, without guesswork, which cows should be kept and which should go to the butcher. The comparative records of dams and daughters show, without guesswork, which bulls should be kept and which should go to the butcher. Thus the same records serve a double purpose.

The record of the dam of any sire is a promise, but the records of a large number of high-producing daughters are the fulfillment of that promise.

The proved sire seems to be the best solution of the dairy-breeding problem. As there is not much to be gained by proving a dead bull, some practical method must be found for keeping a bull until his daughters have been tested for production.

In the nature of things, all proved sires must belong to the aged bull class, and if such sires are to be in general use some method must be worked out by which the young dairy bull, after being tried out on a limited number of cows, may be kept until proved through the records of dams and daughters.

Records of dams and daughters furnished by cow-testing associations show clearly that good bulls are needed if the average production of our dairy cows is to be increased. They also show that production is rapidly increased through the use of proved dairy bulls. The time is ripe for a nation-wide campaign to conserve such bulls for the benefit of the dairy industry.



# **ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE**

February 5, 1926

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